

RECOLLECTIONS OF FIVE TOURS
IN WEST AFRICA.

by

J. B. ALEXANDER.

M.A., M.B., Ch.B. (Edinburgh)

D.P.H. (Cambridge).

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I.

I N T R O D U C T O R Y.

The conditions under which a Medical Officer in the West African Medical Service carries out his duties, are not such as permit of his performing a detailed and prolonged investigation of disease, unless he happens to be stationed in one of the larger towns, where work is more domiciliary, and where laboratory equipment and material for investigation are readily available, and even then medical duties may be so exacting as to preclude any chance of confining his attention to special work.

In the administration of the Service, Medical Officers are appointed to districts with residence at central stations, and sudden calls to outlying parts are frequent, either to attend an urgent case of illness, or to investigate an outbreak of disease, already epidemic or liable to become so. This lack of continuity in service was accentuated during the war when quite one third of the staff was on Military duties in other countries, and, with no new arrivals to replace the vacancies caused either by death or other factors, the work of the remaining individual members/

members was greatly increased, and the service was only maintained by a general prolongation of tours and a curtailment of furloughs.

I do not put this forward as an excuse for this Thesis, but merely as an illustration of the difficulties under which this Service has laboured since its inception, and of the disadvantages, which it has overcome and is overcoming, in its mission of carrying into the heart of West Africa the benefits of European science.

In the smaller outlying stations, the only instrument of precise investigation available is a microscope, but stains deteriorate at such a rapid rate that their use is restricted, and results obtained are often unreliable.

During my first tour I was sent to one of these stations in the Northern Territories of the Gold Coast, and the microscope I found there was an excellent instrument, but there was no suitable place to use it, except upon the rough table in that part of the mudhouse used as a dining room, where it was exposed to the tornadoes of the rainy season, which came on with startling suddenness and frequently swept the microscope and all the surrounding impedimenta into the compound, and to the heat and dust storms of the/

the Harmattan season, which penetrated into the barrel of the instrument and obscured the lenses.

With the aid of Labour from the Prison, I set about building a small laboratory of mudwalls and thatched roof, with rough-hewn wooden benches and shelves. A small compact soldering set was a somewhat lucky inclusion among my kit when I left England, and with this I fashioned a rough still out of Kerosene tins, which provided me with abundant distilled water, more reliable than that received by the irregular supply from headquarters. I was also able to make a rough incubator, but the only medium I could make was a simple broth and my supply of test tubes was extremely limited.

For staining purposes I prepared a stain with Methylene Blue and Eosin powders according to the proportions used in Wright's formula, and used the hobs of the mud stove in the kitchen for the heating part of the operation. With this improvised stain, which had frequently to be dried in the sun before making a fresh supply with Methyl alcohol, I got better results in blood work, than with any of the other prepared stains kept in bottles or supplied in tablet form.

Investigation of Malaria could not go much beyond the examination of blood slides, and one conclusion I/

I came to was that it was extremely difficult to find parasites in smears from the peripheral blood, either in the young growing forms or as crescents, even when the subjects, from which the smears were taken, showed all the characteristic signs and symptoms of Malarial infection. Out of close upon two hundred and fifty examinations made during this tour I only found crescents in three cases.

Work under such difficulties could not be productive of much result, but it afforded infinite pleasure in a lonely life, where one's ordinary duties engrossed only a small portion of the day.

Laboratories are however doing good work in the larger towns under trained observers, but they have to depend almost entirely upon the material available in the towns, in which they are located, and upon occasional specimens from the more accessible of the stations.

II.

TRYPANOSOMIASIS.

When taking over the station of Salaga at the beginning of my first tour, from the Medical Officer whom I relieved, I was informed by him, that he had found notes and reports prepared by his predecessor upon cases of Trypanosomiasis at a village in the district named Kawlaw, distant about two days' march from the station. He had been unable to make a visit and investigate the condition, but thought the matter required clearing up.

For some months at the beginning of the tour I was mainly interested in local work, and was unable to get away, but later I went on a tour of inspection through the district and made Kawlaw my first main stopping place. The village consisted of about a hundred houses of mud and grass, the majority of them being in a ruinous state and empty.

Generally speaking the place had a most deserted appearance as if suffering from a rapidly progressing decay.

It was distant about a mile from the left bank of the Volta River, although during flood times the water came much nearer. The domestic water supply was /

was obtained from this river, and was fetched by women and children who carried their pots upon their heads along a winding path to a spot on the bank, which had apparently been the collecting ground for indefinite years.

Tsetse flies were numerous but *glossinae morsitans* and *fuscus* were in the majority, and only about two per centum were of the *palpalis* variety. The flies settled upon the naked backs of the drawers of water, while they were in a stooping posture, but the victims seemed to sense the approach of the flies and were adepts in flicking them off from any position. The flies followed them back along the path, some persisting until the village was reached, and I myself found it necessary, when taking an afternoon siesta, to do so under a mosquito net in order to escape their attentions.

The population of the village was close on two hundred, and all the inhabitants were paraded for examination.

Practically every child exhibited an enlarged spleen - enlargements being most marked between the ages of two and eight years. Generally speaking the inhabitants were of a good type as bush races go. Nearly half of the number had enlarged glands in the neck, axillae and groins. In those cases where the enlarged/

enlarged glands were confined to the sterno-mastoid region, punctures were made and smears spread upon slides, but in almost every case localised conditions - such as wounds, scars and dirty scalps - were found to account for the enlarged glands.

A blood smear was taken from every case, and in cases with any suspicious signs - such as glands in the sterno-mastoid region alone - thick and thin smears were taken.

After this examination and collection of material, a Council Meeting with the Acting Chief and his Elders was held, and, after the preliminary greetings, I asked if they were familiar with the disease known as Sleeping Sickness. The reply was in the affirmative and they knew the symptoms and signs of it when it developed. I then questioned them upon some of the details in the report of the previous investigator. There were four cases which he considered very suspicious of Trypanosomiasis and had named and described.

Two of them were elderly women and were now dead, and I could elicit nothing that pointed to their having developed or died of Sleeping Sickness, and the Members of the Council were most emphatic in their opinion that they had at no time exhibited any sign or symptom, which could be attributed to the disease. The/

The two other cases were young men and they had left the village, but were known to be still alive and, according to information, showed no sign of developing disease.

My next question was to ask whether they had any explanation to give for the depopulation of the village, and it was somewhat difficult to elicit information upon this point, as the matter appeared to be of a somewhat intimate nature.

However, after a time, I was able to gather that their Chief upon his appointment to the stool, as the office is designated, had moved to a larger village, taking a considerable following with him.

He was influenced in making this move by a superstitious feeling that the office of Chief was under the spell of a baneful ju-ju or evil spirit, since the two previous occupants of the stool had died very shortly after their election. The existing Chief had afterwards been appointed paramount Chief of the district with residence in the selected village, and since the time of his departure small numbers of the inhabitants of the old village had migrated at intervals. A further source of trouble had arisen in the shape of hordes of baboons, which harried their farms and stole the produce, and the complete evacuation of the village was under consideration.

I visited the town in which the Chief lived, ten days later, and had him before me. The story I received at Kawlau was substantiated in every detail, and the Chief could give me no history of any cases of disease which went on to Sleeping Sickness.

Upon my return to my Station a few days later I began a systematic examination of all the smears I had taken and every specimen was negative to trypanosomes.

A large number of the blood slides, particularly those from children, showed an eosinophilia, probably due to helminthic infections, whilst a considerable number showed an increase of large mononuclears with malarial pigmentation.

In view of the evidence obtained from the people, and the results of the examination of the inhabitants and of the specimens taken, I came to the conclusion that, notwithstanding the reported presence of cases suspicious of Trypanosomiasis, the disease was not existent in the village at the time, and that other factors were active in causing the depopulation.

The whole district, in common with the lower half of the Northern Territories and the adjoining part of Ashanti, is very sparsely populated, villages being mostly small and often twenty miles distant from/

from one another.

Various causes have been operative in bringing about this depopulation. Slave-raiding was very common in the old days, but disease has also played a large share. Notwithstanding the fecundity of the people, the high infantile mortality from premature birth, malaria, injudicious feeding and other causes, is responsible for only a small proportion of the children born going on to adult life.

Sleeping sickness is not unknown in these regions, and I have seen three cases at one time in Coomassie Hospital amongst natives of these districts.

In support of this view of its endemicity, ample evidence is found in the Historians of the Gold Coast that the disease has for centuries been known to the natives of Ashanti, while at the present time it annually claims a few victims, but only a few, although tsetse flies are very abundant.

The introduction of the parasite of Trypanosomiasis into certain Tsetse belts in Central Africa and particularly Uganda, has resulted in great epidemics with an enormous death-rate among the people affected.

The disease has no doubt taken its toll in Ashanti and the Northern Territories of the Gold Coast, and in the process a hereditary immunity has been acquired.

Such an immunity is difficult to explain but in the endemicity of Yellow Fever a striking parallel is found - in the extents of its ravages in years gone by, and in the sporadic occurrence and comparative mildness of the cases that occur amongst natives at the present time, in contradistinction to its virulence amongst the non-immune.

III.

TRYPANOSOMIASIS AMONGST HORSES.

Horses were found to be particularly liable to infection by Trypanosomes, if taken out of the station, and as belts of tsetse flies existed to the North, horses could only be brought down during the dry season. Below Salaga even in the dry season tsetse flies were so numerous in certain areas that even with night travelling and smoke precautions it was difficult to prevent the animals being infected. Of one batch of fourteen selected ponies brought down under all precautions possible, ten were infected between Salaga and Coomassie, and died shortly after reaching the latter town.

In the treatment of those cases which came to my notice in Salaga, I tried Atoxyl intravenously with no success. There was usually a slight improvement for a little time with a subsequent exacerbation of symptoms, which necessitated destruction of the animals.

One case, however, gave astonishing results.

A horse belonging to the Chief of Salaga was brought to me on October 26th, 1911. He had been ailing for some time and the Chief held no hopes of his/

his recovery. A solid ridge of oedema extended along the middle line of the abdomen, and the scrotum and penis were very oedematous. The hind legs were swollen to well above the knees. The coat was staring and the eyes glazed, and the head had a most pathetic droop. The temperature per rectum was 104° F. A blood smear was taken and an average of five trypanosomes was found in each field, and numbers of actively dividing parasites were seen. I had discovered in the Hospital a bottle of Soamin Tabloids which, from their appearance, must have been of considerable age, and, as all my Atoxyl was finished, I thought I would give the other a trial.

I started with an injection of 10 grains intramuscularly, and on October 29th took another specimen of the blood and found the trypanosomes much fewer in number per field. The horse appeared better, was eating well and the temperature was 100° F.

On November 2nd an examination of the blood showed trypanosomes much fewer, a number of broken-up and degenerated parasites being seen. The oedema had almost disappeared from all the parts affected and the eyes were brighter.

The improvement was maintained under weekly doses of 10 grains of Soamin for eight weeks, and in addition ten minim doses three times a day of Fowler's Solution/

Solution were begun on November 16th.

At the end of five weeks trypanosomes were absent from the blood examined, and weekly examinations for another month showed no recurrence.

The degenerative changes seen in the parasites were extremely interesting to watch. They became increasingly swollen and vacuolated, while the nucleus appeared to break up, and the chromogen was relatively increased in amount, and consisted of small lumps spread throughout the body of the parasite, and extending in some cases even into the flagellum. These broken up lumps of chromogen absorbed the stains - weak carbol-fuchsin or Leishman - exceedingly well, and the parasite was well delineated.

Unfortunately the horse developed Epizootic Lymphangitis late in December, which resisted all treatment and he had to be shot. Slides taken during this time showed no recurrence of the parasites in the peripheral circulation.

The action of Soamin in this case was remarkable for its rapidity and selectivity as indicated by the gradual decrease of the number of parasites in the field, with the comparative preponderance of degenerated forms over healthy forms, and in the disappearance of symptoms with an apparent recovery.

It/

It may be that the Soamin had undergone some chemical alteration from keeping, but of the effectiveness of this particular brand in this case, there was no doubt.

The onset of the dry season deprived me of any fresh cases, which might confirm or negative the results obtained in the case detailed.

IV.

TRYPANOSOMIASIS AMONG CATTLE.

During March of 1912, there was a large outbreak of Pleuropneumonia among the herds of cattle which were being brought down from French West Africa for sale at Coomassie and other towns on the Coast.

The cattle that were slaughtered at Salaga were purchased from these herds as they passed through, and very few of the local herds were killed.

The average number of cattle killed per day was four, the number varying with the facilities for obtaining them and with the incidence of festivals.

The examination of one hundred cattle was undertaken with a view to determining whether trypanosomiasis had any predisposing effect towards the development of Pleuropneumonia, since, considering the prevalence of the former disease it seemed possible that it rendered them more liable to develop any highly infectious disease.

Of the cattle killed during the period under observation, 19% were found to be suffering from Pleuropneumonia. This disease is more common at the beginning and end of the rainy season, when the herds come down in large numbers. Very few are brought down/

down during the dry season owing to the lack of water at convenient stages, or during the height of the rainy season owing to the difficulty in fording some of the larger rivers and swamps.

The disease had relatively speaking little effect upon the appearance of the animal, as all the beasts were of a thin and lanky type, and after such long marches, as they had to do, were in poor condition. Even in cases where both lungs were widely affected, the animal did not appear to be very ill.

The breathing was rapid, depending upon the degree of infection, and in the earlier stages the temperature was raised a few degrees, but later it was not much affected. The post-mortem appearances varied from a red hepatisation of part of a lung, to a complete consolidation of lung tissue and obliteration of the pleural cavities with a cheesy-looking fibrinous exudate. The lungs were very friable and in the later stages, of a slate-grey colour.

Smears from the lungs showed a fibrinous amorphous material, degenerated epithelial cells and leucocytes, numerous streptococci, diplococci and bacilli of various types, but nothing of a uniform or specific nature was found.

Blood smears and spleen smears were taken from every beast and examined for trypanosomes. They were easily/

easily demonstrable when present in the blood, but in the spleen they disappeared very quickly after death, and in the majority of the cases, where they were already demonstrated in the blood smear, they were only found with difficulty in the spleen smear and frequently not at all. From the results obtained it was found that 31% of the animals were infected with Trypanosomes and 19% were suffering from Pleuropneumonia, while in only 2% of the whole were the two diseases coincident, and in both these cases the infection with trypanosomes was a small one.

The conclusion arrived at was that the passage of the cattle through the upper tsetse belts and the development of Trypanosomiasis did not render the cattle more prone to Pleuropneumonia, and that the latter disease was probably maintained endemic by the infection of the watering pools and resting places along the caravan route.

V.

FOUR CASES OF UNIQUE CHARACTER.

While stationed at Tarquah in the Gold Mining Area in my second tour, I saw four cases of disease and injuries which presented somewhat unique features worthy of record.

The first was a case of Tetanus in a native farmer, who was brought into Hospital with an injury to his right hand and arm, caused by the premature explosion of dynamite, which he had been using to blow up fish in a river. As the use of an explosive for this purpose is an offence under the law, and as that which he had been using was in all probability pilfered from the Mines supply, the victim was badly scared at the result of the accident, and crawled away into the bush, where he lay hidden for two days before being found and brought into hospital.

His right hand was shattered beyond recognition and the lower ends of the radius and ulna were also broken up, and, as a result of the long delay, the skin and tissues were emphysematous and gangrenous up to the junction of the lower and middle thirds of the forearm. After a preliminary cleaning I amputated just below the tuberosity of the radius and at this region/

region found the tissues and vessels quite healthy and ample flap covering available.

During the night after the operation the patient developed chloroform mania - a condition which I have seen on three occasions among natives after general anaesthesia - and in the absence of the dresser, he got out of bed, tore off all his dressings and rolled about on the gravel path in the hospital compound. The Dresser found him there and with assistance was able to get him back into bed, and washed up the wound and redressed it. In the morning I examined the stump and found it apparently clean and put on fresh dressings.

Two days afterwards the flaps appeared swollen and oedematous and there was a considerable amount of discharge between the stitches. I removed five of them and found the stump cavity swarming with fly maggots. These were cleared out and the cavity well swabbed with Carbolic Lotion (1 in 20), and the skin flaps were fixed with strapping and a tube inserted.

The cavity was daily syringed with an antiseptic lotion and healing went on uninterrupted. Four days afterwards the dresser in his morning report stated that the patient had some trismus and stiffness of the neck muscles, with difficulty in swallowing. This gradually extended to all the muscles and he had two severe/

severe fits while I was in the hospital. He was given an injection of Morphia hypodermically, and also thirty grains each of Potassium Bromide and Chloral Hydrate per rectum. He was put on four hourly rectal injections of Bromide and nasal feeding was adopted as a routine measure. He lay in a stuporous condition but had no more signs of muscular irritability.

The dosage of Bromide was gradually reduced and stimulating diet given, and after a week the Bromide was stopped. At the end of three weeks the only part left unhealed was a small patch about the size of a sixpence, at the inner end of the scar, and the rest of the seat of operation was quite firm after granulating up.

The patient had been up and about for a few days, and was feeling well and exceedingly pleased with himself, when one morning a serious accident case was brought in. A boy of about seventeen had been taking a free ride upon one of the rail cars and falling off was run over by the next coach, both legs being nearly severed above the ankles.

After first-aid treatment at the Railway Station, he was brought to the Hospital upon an open stretcher, followed by a large crowd of his friends. The tetanus patient happened to be seated upon the front verandah of the Hospital at the time and witnessed the arrival of/
of/

of the crowd, and saw the broken and mangled legs of the unfortunate boy on the stretcher.

During the same afternoon the Dresser telephoned to me that the first patient had begun his tetanic fits again, and I instructed him to revert to the same treatment as before. The patient appeared to react somewhat to this for a little time, but during the night the fits became more severe in character and more frequent in occurrence. Rigid oposthotonus developed and the patient died in a fit the following morning, notwithstanding that Bromide and Chloral were pushed to the utmost.

I have no doubt that in this case the tetanic toxins were absorbed from the lacerated hand, and that the shock of operation stirred up the toxins after the seat of generation had been removed.

No further toxins being added to those already fixed in the motor nerve cells in the spinal cord, the fits gradually died down under sedative treatment, and the patient might have gone on to complete recovery with an ultimate immunisation of the tetanus toxin, had not the exciting stimulus, which the sight of the other accident provided, produced such a general disturbance of the nerve elements, that the toxins were able to regain control and prove the end of the patient by exhaustion.

The other three cases were seen in the post-mortem room.

The first was a case of Rupture of the Lung, presumably spontaneous. This occurred in a well built negro of about fifty years of age, and a watchman by occupation.

He came home from his overnight duties complaining that he had been taken suddenly ill with pain and a feeling of oppression in the left side of the chest. He lay down upon his mat straightway and died shortly afterwards. The only additional information, that could be obtained from his friends, was that he was a fairly heavy gin drinker, and his general appearance tended to confirm this.

At the autopsy, the abdomen was first examined but nothing of note was found except that the liver was enlarged, pale in colour, and greasy to the touch. On section, it had the pale fibrous appearance of alcoholic fatty infiltration.

On examining the thorax; the left pleural cavity was found full of dark blood. The left lung was gently explored and no adhesions were found. The chest wall was resected further in order to facilitate inspection, and on mopping up the blood, I found a ragged tear of the lung tissue extending from the inner/

inner aspect of the left apex down almost to the root of the lung. In length it was from $2\frac{1}{2}$ to 3 inches and extended into the lung tissue for an inch and a half about the centre of the tear.

At the bottom of the fissure, near the middle, there was a healed nodule of the size of a marble - probably tuberculous in origin - but there was no cavity formation, neither could any Tubercle Bacilli be found in section of the nodule nor in smears from the lung tissue.

The upper lobe of the left lung was in a very engorged state, with the appearance of red hepatisation of acute Pneumonia, while the rest of the lung tissue was normal in appearance although slightly oedematous upon section.

The heart was healthy, although considerably hypertrophied, and no other pathological condition of note was found.

The causation of such a rupture is obscure - the only explanation that seems feasible is that with an incipient pneumonia, some violent effort, although no history of such could be obtained, was responsible for the break in the continuity of the friable lung.

The second post-mortem case was one of Rupture of the Spleen from muscular effort.

A woman of a strong, healthy appearance and of thirty/



thirty years of age, was brought into the post-mortem room one morning by the Police.

The history that was obtained from them and her friends, was that she was pounding fu-fu the previous evening, and while so engaged, she complained of pain in her left side. She lay down and expired shortly afterwards.

The domestic duty upon which she was engaged at the time consists in pounding maize in a large wooden mortar with a heavy stick about four feet long. The stick is about two and a half inches in diameter and expands at either end like an ordinary pestle.

In operation it is grasped in the middle and raised in a perpendicular direction and brought down with considerable force upon the material in the mortar. In this action the operating arm is raised to the full extent above the head, and as considerable muscular exertion is entailed in the work, the pestle is worked in alternating spells by both arms.

Two women usually pound at the same mortar with a rhythmic and accurate action which is extremely interesting to watch. The attached photograph illustrates well the process in the different stages of its rhythm.

At/

At the post-mortem examination, I found nothing wrong until I explored the spleen. A ragged tear two inches long was found in the upper anterior border, and the haemorrhage was confined to the left hypochondrium, being restricted in its spread by the gastro-splenic omentum. The spleen was about three times the normal size, darker in appearance and more pulpy than usual. There were no marked adhesions beyond a well developed gastro-splenic omentum. No malarial parasites could be found in smears taken from it, but there was a considerable amount of dark pigment. All the other organs were healthy but the heart was dilated and full of blood.

The amount of blood extravasated was much smaller than might have been expected from a tear in such a vascular organism, and the woman must have collapsed immediately after she complained of the pain in her side. The resultant shock must have produced a reflex failure of the heart and limited the haemorrhage.

There is no doubt that in this case the extreme muscular effort entailed in the operation of pounding fu-fu, whereby the muscles on one side are alternately on the stretch and in a state of contraction, and the sudden jar with which each movement is stopped, were responsible/

responsible for the rupture of the spleen, and that shock was the actual cause of death.

As a cause of death, Rupture of the Spleen is more commonly found from external blows or injuries, and of this complication in enlarged malarial spleen, Castellani and Chalmers on page 889 say, "rupture as the result of blows or injuries is by no means unknown, though not common, and requires prompt surgical attention. We have only come across one case in our experience."

Manson on page 97 of his "Tropical Diseases" says.- "Apart from direct violence, an enlarged spleen may rupture spontaneously owing to sudden accession in size in the course of a fever fit. It sometimes happens that the presence of adhesions limits and restrains the haemorrhage. Localised haemorrhages of this description may, in time, lead to splenic abscess."

Spontaneous Rupture of the Spleen has received more attention lately in medical circles in this country owing to some cases occurring among men who contracted malaria during the war. Cases are recorded in the issues of the British Medical Journal of April 24th, June 5th and June 19th of this year, and are instanced as evidence for early operation.

In the case recorded above, operation was out of/

of the question as the patient was allowed to lie until she died, and death supervened very rapidly. It is doubtful whether in her case there would have been a sporting chance of recovery even with an operation undertaken immediately after the accident, as the shock was undoubtedly a more potent factor in causing death than actual haemorrhage from the organ.

The third case was one, which, amidst many complications, presented a most interesting one in the form of a hernia of the large intestine retro-peritoneally.

This occurred in a boy, aged about 20 years, who was said to have been ailing for a long time. He came off the train at a station about seven miles from my Station and died on the platform. He was brought into the post-mortem room by the Police.

External appearances showed considerable swelling of the legs and abdomen - dropsical in character. On opening the abdomen it was found full of ascitic fluid. The omentum was matted and adherent to various organs. The gastro-colic and gastro-splenicomenta were drawn by adhesions over the spleen which was enlarged to four times its normal size, and was removed with difficulty owing to the adhesions to the pre-nephric tissues.

The/

The large intestine was thickened and nodular to the touch, owing to dysenteric ulceration of prolonged duration. Adhesions were abundant fixing the bowel to the posterior wall, and, on following the descending colon, I found that it began to dip about three inches from the splenic flexure in an outwards, backwards and upwards direction behind the matted mass connecting the spleen and kidney, into a pocket behind the inferior pole of the left kidney. The prolapsed portion could be pulled out quite freely, although the rest of the descending colon was tied down to the back wall of the abdomen by adhesions.

The kidneys appeared fairly healthy but the liver showed considerable fatty degeneration. The lungs were solid and the pleurae adherent all over. The heart was dilated and the left ventricle hypertrophied. The wall of the right ventricle was thin and pale and had the appearance of fatty degeneration while the chamber was full of venous blood. There was a small amount of pericarditis with organised adhesions.

Death was apparently due to heart failure following the lung conditions amidst the many other complications.

The matting of the omentum and formation of adhesions were obviously the result of old peritonitis following/

following Dysentery, as the large intestine was greatly thickened, and on section still showed excessive ulceration along its full extent.

The prolapsed loop of the intestine being free from adhesions had formed a pocket for itself, in which it was freely movable, and in which, had death not supervened from other causes, it would at some future date have been very liable to strangulation by the surrounding adhesions.

VI.

M A L A R I A.

In June of 1912 after I had completed nine months of my tour, I had my first attack of malarial fever. During the dry season, which was a prolonged one and lasted from November to May, very few mosquitoes were seen in the bungalows, which were almost a mile from the native town. The segregation was not, however, complete as accommodation for about fifty soldiers and their wives and children was provided in the form of rows of round huts, which were only three hundred yards distant; and, notwithstanding the precautions that were taken to prevent mosquito-breeding in household utensils and pots, they began to be very abundant during the month of May, although the actual number was small, in comparison with that which prevailed in less well-regulated areas.

The actual clearing in the Cantonment area was extensive, but it was impossible to supervise all the breeding places which were concealed in the surrounding belt of long grass.

The weather got considerably cooler with the onset of the rains, and the relative difference between the day and night temperatures became much more appreciable./

appreciable. The District Commissioner was the only other white inhabitant in the station, and, owing to the fact that the Medical Officer's bungalow was stripped of its roof by one of the first tornadoes of the season, we were occupying the same building. The District Commissioner went down with Fever one day and I followed suit next morning. The periodicity of the fever in each case was strictly quartan, and the bouts were each finished in two cycles. The second cycle in each case was marked by much more severe symptoms, and more pronounced and prolonged fever than was the case in the first, while my symptoms were relatively more severe than those of the District Commissioner; my temperature rose to such a degree that a mild delirium set in. Vigorous quinine treatment was exhibited during the attack, but did not prevent the second rise of temperature on the fourth day. Quinine was not administered until a falling temperature was produced by antipyretic measures.

Blood examination showed no parasites at any stage, although a marked mononuclear increase was present in both cases.

On my arrival on the Coast I had started taking quinine as a prophylactic measure according to the method, that was, I believe, greatly favoured by the Germans/

Germans in West Africa. Ten grains were taken on Sunday and on Monday, and five grains on Wednesday. They considered this concentration on two days more effective than five grains daily. This regular exhibition of quinine was probably responsible for the absence of parasites from the peripheral blood.

The coincidence of the two attacks would make it appear as if we had both been infected at or about the same time, but for about six weeks before the date on which the District Commissioner went down with fever, we had only been in the station for a few days together, and it may be that we had both harboured parasites for a considerable time, and the sudden onset of cold weather had devitalised us sufficiently for the parasite to get the upper hand.

I do not see however, how two men, who felt and who undoubtedly were so extraordinarily fit as we were, could be devitalised by the onset of cold weather to such an extent as to make us liable to such a sudden and practically simultaneous outburst on the part of the parasites.

We were both in good health, being accustomed to a vigorous outdoor life with a good dietary, and we were also both of a sanguine and cheerful temperament and not liable to be affected by meteorological changes.

There is, however, another supposition that the parasite of malaria has, like its insect host and other members of nature life, a time of selection for propagation of its species, and that this period corresponds with the season when mosquitoes are most prevalent, and the parasite in the peripheral blood has xxx the greatest chance of being taken up by its intermediary host.

Hospital records on the Gold Coast invariably show that the cases of malaria are most numerous a month after the onset of the rains, and the curves of rainfall and malarial incidence show a remarkable similarity in their range and outline - that of malaria being displaced to the right when the base line represents days and months of the year.

Mosquitoes are most numerous about a month after the rains begin, and the lowest range of temperature generally occurs about this time also, so it may be that the combination of the two phenomena accounts for the increased number of cases of malaria - the parasite finding all conditions most favourable for its propagation.

Having found that, notwithstanding rigid adherence to the German formulary of quinine prophylaxis, I was unable to prevent a fairly severe attack of malaria, I reverted to the more generally accepted routine/

routine of five grains daily.

My treatment during convalescence from the first attack was apparently not vigorous enough, and the daily dosage of five grains, adopted after it was over, did not prevent an exacerbation of the infection which culminated in a sharp attack three months later, when I had begun my trek down country to go on leave of absence.

I had a twelve days march to do and was ill for five days, but after this was over I persisted with twenty grains of quinine daily, for a week, fifteen grains daily for another week, and ten grains daily during the third.

By this time I was well across the sea, towards England, and had passed the Canary Islands. I took no more quinine, and although I arrived home in November and spent four winter months on leave, during which I frequently got wet and exhausted whilst shooting and taking other forms of outdoor exercise, I had no further attack.

The treatment adopted would therefore appear to have been drastic enough as I have had no fever since that date.

During the last four tours I have been resident in stations where segregation is much more complete, and malaria not so prevalent amongst the natives owing/

owing to advances in Sanitary Improvements, and have taken no quinine as a prophylactic, except when I went upon visits of inspection to other stations and had occasion to sleep in rest houses. When such visits were undertaken, I started taking a daily dose of ten grains immediately after leaving my own station, and maintained this until a week after my return. It may be that upon these visits I was not bitten by an infected mosquito or mosquitoes, but such an escape I can hardly imagine possible, as in practically every outlying village mosquitoes are numerous and malaria is very prevalent.

From my experience of a large number of cases during my five tours, I am convinced that the regular exhibition of five grain doses of quinine daily is not an absolute preventive against malaria, but it does, in my opinion, tend to lessen the severity of the attack, when it does come along. A larger dose is necessary, but I do not think it possible for the ordinary person to maintain a dose of ten grains daily for a very prolonged period, e.g. over a Tour of a Year or eighteen months in West Africa.

There is no doubt that, since the exhibition of the daily dose of five grains of quinine has become a doctrine preached by a paternal Colonial Office and practised by the most amenable and wise section of/

of its servants, whose duties call them to West Africa, the severity of the types of Malarial infections seen amongst the white population of the Gold Coast in particular has greatly diminished, and there is no longer seen in the Hospital Records such appalling lists of bilious, remittent and malignant fevers.

Another point which I think is worth mentioning is the exhibition of quinine in the treatment of an attack. Quinine given on a rising temperature is positively harmful and from experience of a considerable number of benign cases in the South of Spain as well as of the more severe types in West Africa, I am convinced that quinine should only be given while the temperature is falling and that once you do get it going down, it may be given in heroic doses by the mouth, is well tolerated and is effective in its action.

I may have been particularly fortunate but I have not once found it necessary to resort to intramuscular injection when I have seen the case before indiscriminate dosage had been started and I was able to adopt antipyretic measures before exhibiting quinine as a specific.

One case that remains in my memory was seen in the South of Spain, where a young Englishman was kept on ten grain doses three times a day for a fortnight and/

and he maintained a remittent temperature all the time. He was taken into hospital, given no quinine for a day, and the temperature watched.

When it reached its fastigium, antipyretic measures were employed and when the temperature fell two degrees, he was given twenty grains by the mouth. After it fell another two degrees in about three hours, he was given another twenty grains and after four more hours, fifteen grains, by which time his temperature was normal and it did not rise again.

Another point which I may mention is the method of using the drug.

The sulphate in acid solution I have always found to be badly tolerated and badly absorbed with a tendency to the production of dyspepsia and bilious sickness.

The hydrochloride in solution can be given in larger doses and is well tolerated. Its effect is more certain and rapid than the sulphate.

An incident in connection with my first attack of Malaria is worth recording. Not being sure that the quinine in stock had not deteriorated, I wired to Tamale, seventy-two miles distant, for a fresh supply at three o'clock one afternoon and the following afternoon a thin, wiry native of about fifty years/

years of age came along to the bungalow with a package of quinine. At the time I thought the parcel had been sent by post to post runners - a system of relays by which Government messages are carried from village to village, - but later I found that the old man has actually covered the seventy two miles in twenty four hours - a fairly remarkable performance in a tropical country.

VII.

YELLOW FEVER.

(a) Early History.

In Reindorf's History of the Gold Coast, there is a clear and well written description of a disease, which proved fatal to four out of five missionaries, who landed at Ningo in 1770.

The practically simultaneous occurrence of the cases, the symptoms described and the extreme mortality of the disease all tend to support the supposition that it was "Yellow Fever". The town of Ningo is a small one and has never been a Government Station, but it is a remarkable fact that when four Europeans, Government Officials, were stationed there in 1917 for over a month in order to deal with some rioting, that had taken place, two of them, who lived together in a house at one end of the town, developed Yellow Fever and subsequently died, while the other two who had selected a house on the beach about a hundred yards distant escaped.

It is interesting to study in the Annual Report of the Medical Department for 1886-7 a description of an outbreak of a disease - five cases of which occurred during one month with three deaths. The symptoms are described as being extremely acute - death being caused/

caused by suppression of urine. A member of the Basel Mission also died of the same disease but it is mentioned that in his case "total suppression of the hepatic functions was superadded to the characteristic renal affection".

Now all these cases occurred amongst Europeans living in an area, which has at frequent intervals, since Yellow Fever has been recognised as existing on the Coast, been the seat of outbreaks - the latest of which occurred in 1913 when 10 cases were diagnosed.

The disease, as described in the Report, was characterised by suppression of urine as a final symptom and hepatic derangements were also present, and as the combination of these is usually found in Yellow Fever more markedly than in Blackwater Fever under which it was diagnosed, I am inclined to think that it was an outbreak of the former and not of the latter.

In the same report two Government Officials are mentioned as having been seized with malignant malarial fever with grave hepatic complications and both recovered.

Out of a population of 46 Europeans who lived within the precincts of the native town, the vital statistics for another quarter of the same year, show that seven were on the sick list for varying periods, four/

four of whom died and three were invalided. Of the seven cases five were classified as Malignant fever, one as Hepatitis and one as Climatic Debility, and of the five cases of Malignant Fever, four died.

The symptoms of these cases are not described, but malignant fever is presumably meant to be malarial in origin, or it is a fever undiagnosed and probably Yellow Fever.

In the Report from the town of Elmina the Medical Officer says. "Among the Europeans the fever was generally of the remittent type and the severe cases were attended with black vomit and albuminous urine. All the European officials in the Castle were attacked by fever which caused one death and of a total of about 23 Europeans resident in the Castle and town for a fortnight and upwards during the quarter, three died of remittent fever."

Here again the cardinal symptoms of Yellow Fever are prominent - remittent fever, black vomit and albuminous urine.

Elmina has always been a notoriously unhealthy place for Europeans and cases of Yellow Fever have been diagnosed with great frequency since the recognition of the disease.

Whilst on one occasion searching through the archives of the Medical Office in that station, I found/

found a report by one Medical Officer, wise and brave beyond his time, who had the courage to report the cases of remittent fever which occurred under his care, as Yellow Fever, and this was a considerable number of years before the disease was admitted to be present in West Africa. His report was accepted with reticence at headquarters, and he was asked to confine his diagnosis to known diseases.

The attitude adopted at the time towards Yellow Fever appears to be somewhat akin to that of the dreamer who keeps his eyes shut after a horrible nightmare and is afraid to wake in case he may find it is real.

In the Annual Report for 1887-8, a sporadic case of Yellow Fever is mentioned as having occurred at Quittah - a coast station on a spit of sand between the mouth of the Volta and Togoland. This is apparently the first official inclusion of the disease, and its presence is passed over without comment.

It was not until 1910 that the disease was given its full measure of notice, and in that year a large outbreak occurred at the port of Seccondée and Sir Rupert Boyce was sent by the Colonial Office to investigate the disease and report upon the outbreak.

As a result of the representations made in his report, /

report, a Commission was appointed to enquire into the endemicity of Yellow Fever in West Africa.

Endemicity of the Disease.

The endemicity of the Disease in West Africa was not officially accepted until the Commission came to a positive conclusion after exhaustive enquiries. It was unfortunate that the intervention of the war rendered it impossible for the keen band of investigators, which had been collected, to continue their researches, and beyond substantiating the endemicity of the disease and disclosing some hitherto unknown features of the *Stegomyia Calopus*, and collecting a considerable amount of useful material, the Commission got no nearer the elucidation of the causation of the Disease.

There is one point upon which their enquiries lead them to make a fatal limitation. They enumerated endemic foci that existed, and others that had ceased to be endemic. This was, in the opinion of most medical men in West Africa, an unnecessary limitation. The disease is endemic in every part.

New foci can be discovered any day, provided a few non-immunes take up their residence in a native town, and live there under the same conditions, under which/

which the immunes live, and without taking those precautions, of which a knowledge has been acquired by bitter experience. The cases which occurred in the village of Ningo in 1917 bear out this contention and new foci have been discovered from time to time by the occurrence of cases in places where Yellow Fever was least thought of - particularly in Ashanti and the Northern Territories, places remote from the Coast.

The disappearance of foci is only an apparent feature, dependent upon local conditions. Until the stegomyia is entirely eradicated there is always a chance of a recrudescence, and in towns, where Sanitation has been maintained at a high pitch, the stegomyia index is low. In Accra a large staff of inspectors with Mosquito brigades is constantly employed, and the mosquito index upon house to house visitation is regularly taken and compared.

If the work of the Mosquito Brigades is relaxed in any way, the curve quickly shows a rise. The Stegomyia has a wonderful facility for changing his habitat, and where rigid inspection excludes them from houses and compounds, they find holes in trees, in water holding plants or other receptacles in the open, in which they lay their eggs. They prefer their breeding places to be domestic, but if they are denied them, /

them, then they avail themselves of the nearest suitable breeding ground.

The *Stegomyia*, which is one essential factor in the maintenance of the Disease, has not been eradicated even from the most carefully inspected and regulated towns.

Yellow Fever in West Africa is now a disease of non-immune immigrants, and it is seldom that it breaks out in an epidemic form among the natives of a town or district. In this respect it differs in its virulence from the disease in South and Central America and in the West Indies, and the supposition is that, through prolonged exposure, a comparative immunity has been acquired in West Africa, while in the countries of the Western Continent, the extraordinary virulence is due to the introduction of the germ into fresh soil.

The relative virulence of Sleeping Sickness in West and Central Africa bears a similar analogy, and both diseases are now only seen in sporadic cases among natives of West Africa.

Yellow Fever is undoubtedly responsible for a considerable number of deaths amongst infants, and repeated light attacks confer upon a certain number an acquired immunity, where the hereditary immunity has become weakened.

Recent Outbreaks in the Gold Coast.

These have been signalised by the diversity of the foci and by a limitation to non-immunes. These non-immunes are Europeans, and natives of other parts of West Africa - principally Kroos from the Liberian Coast.

The following table shows the number of cases that occurred from 1910-1918, and the foci are scattered without any relation to trade routes or other means of spread. The presence of *Stegomyia* Calopus and of non-immunes have been the determining factors.

TABLE/

	1910	1911	1912	1913	1914	1915	1916	1917	1918
Accra	-	8	1	8	2	-	-	-	-
Christiansborg	-	-	2	2	-	-	-	-	-
Labadi	-	-	5	-	-	-	-	-	-
Abokobi	-	-	-	2	-	-	-	-	-
Somanya	-	-	-	-	1	-	-	-	-
Quittah	-	-	-	2	3	-	-	-	-
Saltpond	-	-	-	1	4	-	-	2	-
Seccondoe	14	-	1	-	-	-	1	-	-
Axim	1	1	1	-	1	-	-	-	3
Ayenim	-	-	-	-	3	-	-	-	-
Kintampo	-	-	-	1	-	-	-	-	-
Bole	-	-	-	3	1	-	-	1	-
Tumu	-	-	-	1	-	-	-	-	-
Tamale	-	-	-	-	4	-	-	-	-
Gambaga	-	-	-	-	-	-	1	-	-
Nsawam	-	-	-	-	-	-	4	-	-
Ningo	-	-	-	-	-	-	-	2	-
Abasso	-	-	-	-	-	-	-	-	1
Totals	15	9	10	20	19	-	6	5	4

A considerable number of new foci have been discovered since the Report of the Commission upon Yellow Fever was issued, and I have no doubt that they will go on being discovered according as the European and non-immune population spreads over the country, and takes up its residence in towns hitherto unoccupied.

Incidence of the Cases.

With the exception of the cases that occurred at Kintampo, Bole, Tumu, Tamale, Gambaga and Ningo, all the other cases were among non-officials, - the trading and mining communities - who lived in the towns above their stores.

In the case of Ayenim, the bungalows, in which the cases occurred, were half a mile from the native village, but upon investigation of the habits of the European miners, it was found that several of them had been in the habit of visiting the native town, after their day's work was over, and spending a considerable portion of the night there. The cases that occurred in the Northern Territories - Bole, etc., were among Government Officials - Medical Officers and District Commissioners, and although these officers lived in bungalows well away from the native town, yet their duties frequently took them upon visits of inspection through/

through their districts, when they had to sleep in native houses in the smaller villages where no rest houses had been erected. All these officers developed Yellow Fever shortly after coming off trek.

Measures taken to cope with the Disease.

These may be summed up under two headings.-

Prophylactic - General.

- (a) Segregation Areas for Europeans.
- (b) Extra-Urban Rest Houses.
- (c) Anti-Mosquito measures.
- (d) Extension of Sanitary Improvements in general.

Prophylactic - Particular.

- (a) Isolation of cases of Yellow Fever.
- (b) Isolation and inspection of Contacts.
- (c) Declaration of infected areas and adoption of Quarantine measures.
- (d) Fumigation of infected areas.
- (e) Anti-mosquito measures.

The disease is therefore widely endemic in the Gold Coast and in West Africa generally, and until the *Stegomyia* mosquito is wiped out or kept within the required limits, will remain so.

General prophylactic measures will succeed in preventing cases among Europeans if they are rigidly adhered/

adhered to, but this is commercially and socially impossible, and there is among the native inhabitants themselves a certain number of non-immunes, who develop the disease and assist in its maintenance. It has been found that Kroo boys coming fresh from Liberia are particularly prone to the disease, and the great majority of the native cases since 1910 has been amongst that class. It may be that the immunity of their own country is not proof against the variety of the disease which exists in other parts of West Africa.



VIII.

AN EXPERIMENT IN FUMIGATION.

In my capacity as Medical Officer of Health at Accra, it was part of my duties to initiate and superintend schemes of fumigation both on a large and small scale, when the necessity for such arose either (1) during outbreaks of epidemic diseases or (2) as a means of ridding buildings of mosquitoes, rats or bats.

For large buildings the Clayton Disinfector is very effective and good work can also be done by burning sulphur in basins. Both these methods were used simultaneously when large sections of the town had to be fumigated as rapidly as possible.

Sulphur however as a fumigant has its disadvantages, when used in private dwellings or in stores. The fumes must be concentrated and they tarnish silver articles, whilst coloured fabrics, which are kept in bulk in stores, are spoilt owing to the combinations that are formed with the dyes. It leaves a very disagreeable odour which makes a room most uncomfortable for habitation for a week or more afterwards.

The rainfall in 1916 was very much above the normal and many of the bungalows were infested with mosquitoes, /

mosquitoes, which bred in the low lying and undrained areas. Christiansborg Castle, the residence of the Governor, was practically uninhabitable owing to their numbers. This was due to the fact that it was surrounded with large water holes, which had been the sole source of supply for the town, and with the introduction of a pipe borne supply in 1914, these holes were no longer used and whilst for some unknown reason, they did not breed mosquitoes when in use, they now bred them at an enormous rate. It may be that the periodic cleaning to which they were previously subjected prevented mosquitoes from being attracted to them, and that the accumulation of impurities through disuse rendered conditions more favourable for the propagation of the mosquitoes.

The water was undoubtedly very stagnant and contained much decaying matter both vegetable and animal, and the *Culex Fatiga* is notoriously a lover of dirty conditions. Whilst these conditions lasted I was frequently able to lift samples out of the water holes, which were almost solid with the number of larvae and pupae developing.

The filling of these waterholes was a prolonged operation as thousands of tons of earth and sand had to be shifted, and drainage was impossible in most cases, as the holes had been dug in basins.

The/

The presence of such hordes of mosquitoes made fumigation an almost daily operation in some place or other. After each fumigation of the Castle, it was uninhabitable for a week or ten days as the building was very damp from its proximity to the sea, and the damp walls held the odour much longer.

It was generally found that, immediately the rooms, offices and dungeons were opened after fumigation, fresh hordes of mosquitoes invaded the rooms.

With such an experience as this, I became thoroughly imbued with the disadvantages of sulphur as a fumigating agent for living quarters, and I started experiments with different chemicals in the hope of devising a small fumigation apparatus which would be suitable for a room of the ordinary size, be easily manipulated and inexpensive and effective in operation, and be without the disagreeable after-effects of sulphur.

I had already done a considerable number of experiments with campho-phenique by vaporising a mixture of camphor and phenol dissolved under heat in a small flat bowl over a methylated spirit lamp, but I found that after opening up the rooms; the mosquitoes although apparently dead were only in a comatose condition, and, after a short exposure to fresh/

fresh air, revived. Prolongation of the action of the fumigant did not seem to have any more potent effect.

I then turned to the different products put on the market, as Cyllin, Lysol and IZAL, and experimented with the first two with satisfactory results.

IZAL I tried last in the form that it is supplied in drums for Sanitation purposes. The apparatus which I used for all the experiments consisted of a small flat basin made of sheet iron and set upon a Tripod with a movable methylated spirit lamp below. The basin held ten ounces without overflowing when the material boiled.

All the experiments with the different fumigants were done in my own office, which was about 1200 cubic feet in capacity.

I had two dozen cages of 6 inches by 3 inches by 3 inches, made of wood and covered with mosquito gauze, with a loose funnel-shaped fold at one end, which fitted over the top of the jar in which the mosquito larvae were bred out.

There was abundant material to work upon, and in each experiment cages - containing from 20 to 50 mosquitoes freshly bred out - were disposed in various positions about the room - upon the floor, in corners, upon the tops of cupboards, inside cupboards and behind/

behind rows of books. Generally speaking I arranged the cages so as to approximate as nearly as possible to the normal resting places of the mosquitoes.

The doors and windows were not pasted up - only the coarser openings such as the ventilators in the ceiling being covered up - and as the doors and windows were very ill-fitting, slits half an inch in width existing at the edges of some of them, the room was only very partially sealed.

The lamp was trimmed in such a way that with three ounces of methylated spirits it burned for three hours, and it was found that it evaporated six ounces of Izal in this time.

After the experiments with similar quantities of Cyllin, Lysol, and Izal, the mosquitoes in the more remotely placed of the cages were found to be alive, although stupefied, on opening up, when the first two were used, whilst with Izal all the mosquitoes were dead and did not revive upon exposure to fresh air. Several experiments with Izal were then done to confirm its destructive power, and in each the mosquitoes were all found dead, but it was noticed that on each occasion a reddish black deposit covered papers and other articles in the room. This was thought to be due to the carbonising properties of the dull iron of which the container was made, and a small enamelled iron/

iron basin was substituted. After it was tried a few times, this appeared to act satisfactorily, as no deposit was seen on any of the occasions.

As a result of these experiments, I decided.-

- (1) that an apparatus suitable for the fumigation of a room of from two to three thousand cubic feet could be devised
- (2) that the apparatus required was simple and should consist of only two receptacles of convenient size to be filled with standard amounts of IZAL and methylated spirits
- (3) that with IZAL no pasting of windows or doors was necessary - only the largest apertures being sealed up - and in this way preparations were reduced to the absolute minimum
- (4) that the exposure necessary with IZAL for effective destruction of the mosquitoes was only three hours - although I found that mosquitoes were generally all dead in a little over two hours.
- (5) that with IZAL, on opening up the room and allowing gas to escape for a few seconds, an entrance could be effected for the establishment of through ventilation, and after this had been in operation for three minutes, it was possible to enter the room and remain in it for any length of time without finding any uncomfortable sensation from the fumes.

- (6) that there were no disagreeable after-effects, no furniture nor other articles in the room were injured, and there was practically no cleaning up, beyond sweeping and dusting, to be done.
- (7) that in comparison with fumigation with sulphur, the labour and materials required were much less costly.

I was so satisfied that the method fulfilled these requirements and that its use could be extended, provided I could get a standard apparatus suitable for rooms up to 3000 cubic feet, that I sent in a report upon it to the Senior Sanitary Officer, the Administrative Head of the Public Health Department on the Gold Coast. This report ultimately found its way to His Excellency, the Governor, who was so struck by all the advantages I claimed for it, that he requested me to fumigate his office immediately, and the Castle bedrooms a fortnight later.

The office was a room of 12,000 cubic feet, and I explained to him that I did not have the necessary apparatus for a room of that size, neither could I be sure of any which I improvised, until I had tested it. However he was insistent that it should be done - so reckless had he become after numerous fumigations with sulphur - and I spent the rest of the day in converting/

converting Alformant lamps to hold small enamel basins similar to the one I used in my original apparatus, and the same evening I set ten of them going in the office.

I opened up after three hours and the sight that met my eyes was absolutely appalling. The room was full of an impenetrable yellow fog - worse than the worst of London's Novembers - and every square inch was covered with a thick layer of soot. Important despatches and Minute papers were buried in a black deposit. His Excellency did not wait long to compare the resentment he felt with the consternation that filled my bosom, but he got up early in the morning and wrote a seven page Minute in red ink upon the dangers of trusting to the ingratiating reports of the Medical Officer of Health of Accra.

It was indeed a great disappointment to me, and the only reason I could find for the mishap was, that the lamps had been too strong, and that either the gases had become ignited and the carbon compounds had been broken up, or that the evaporation had gone on so rapidly that the lamp continued its action upon the residuum left in the basin, until it actually carbonised it.

At a later date I set a strong lamp under one of the basins with little protection from the flame and/
and/

and the gas as it left the basin took fire and produced a dense smoke. I am inclined to think therefore that this was what happened.

Profiting by the experiment which was unfortunately carried out where I had never intended it, I took all the lamps back to my office next morning and set the entire number in operation. I trimmed the lamps so that the rate of evaporation would not exceed six ounces in three hours.

On opening up my office, after the usual time, I found a dense white gas which must have been ten times more concentrated than usual, and there was not a trace of black deposit.

A fortnight later I was in a strong enough position to inform his Excellency the Governor that I intended fumigating the bedrooms in the Castle in accordance with his original request.

Three large bedrooms of five thousand cubic feet each were done without any pasting precautions, and without disturbing the furniture or other contents of the rooms. I opened up after three hours and the dead mosquitoes were lying about in thousands. One could hardly walk across the floor without putting one's foot upon a dozen or more at each step.

I was able to demonstrate the destructive powers of the fumigant to the Governor and to point out that even /

even the whitest of surfaces in the rooms showed no black deposit. The rooms were in use within an hour and were slept in the same night, and this would have been impossible after fumigation with Sulphur.

The simple apparatus, which I had worked with, was capable of extension locally, owing to there being a stock of alformant lamps in the Medical Stores, and numerous bungalows and offices were fumigated later, and, when a case of Yellow Fever occurred in Victoriaborg, the residential quarter of the Government Officials, the bungalow affected and a large number within the infected zone, were done with excellent results and no untoward happenings, and with the least inconvenience to the occupants.

Each set of the apparatus was only considered capable of dealing efficiently with spaces of 1500 cubic feet, so that the sets had to be multiplied.

I tried various manufacturers in England in the hope of getting them to turn out a standard apparatus suitable for spaces of 3000 cubic feet, and enlisted the help of Messrs Newton Chambers & Co., Sheffield, who are the manufacturers of Izal. They were extremely keen on the process, but owing to the pressure of war work, no firm would undertake to supply me.

Unfortunately after the war was finished I was unable to pursue the work, as I was acting Senior Sanitary/

Sanitary Officer, and the administrative work, along with the amount of travelling which I had to do in the investigation of sporadic outbreaks of Yellow Fever and other infectious diseases, precluded me from giving attention to anything else.

After I had been in communication with the manufacturers of Izal, they sent me a supply of the oil from which the commercial emulsion is made, and I experimented with it, but did not get such satisfactory results.

I constructed a box with four chambers in series - the dimensions of each chamber being two feet each way. A window four inches wide by two inches deep was cut in the upper part of each of the three partitions, and was fitted with bronze gauze so as to prevent the mosquitoes passing between the chambers.

The apparatus for vaporising the fumigant was fitted under one of the end chambers, and was so arranged that the fumigant passed direct into this chamber and percolated through the gauze slits into the succeeding chambers.

Glass windows were put in the front of each chamber for inspection purposes, and four doors were fitted at the back for the introduction of the mosquitoes, which were bred out in jars with gauze cages/

cages attached. When an experiment was to be done, forty or fifty freshly bred out mosquitoes of different species were introduced into each apartment.

I tried the Izal oil first and the results were most disappointing - the mosquitoes in the end cage being all alive after three hours.

Campho-phenique was next tried and several mosquitoes were alive in the third apartment after three hours, and a large number revived after exposure to fresh air.

One of the Alformant "A" lamps was fitted under the end chamber and formalin tablets to the number recommended were vaporised and the results were equally disappointing - the mosquitoes in the end chamber being all alive after six hours.

The apparatus for vaporising Izal was again fitted, and an experiment conducted with it, notwithstanding that the experiment with Izal Oil had been so disappointing. The mosquitoes in all the apartments were dead in two and a half hours - those in the first cage being killed within a few minutes of lighting the lamp.

With each fumigant tried in the strength requisite for 1000 cubic feet of space, the mosquitoes in the first two chambers were fairly quickly killed, but Izal/

Izal surpassed the others in its penetrability and efficiency.

The apparatus is still being used regularly on the Gold Coast for fumigation purposes by the Sanitary Department, but I have not been able to advocate its more general use. I am still hopeful however of devising a suitable and easily manipulated apparatus, and have been experimenting with Pyramid night lights as a source of heat.

My chief aim is to get a standard apparatus which will evaporate a pint of Izal at a steady rate over a period of three hours.

IX.

I N F L U E N Z A.

The first recorded outbreak of this disease started at the end of 1891, and in 1892 it became malignant and so rapidly fatal that a state of panic was induced amongst the natives, and dead were left unburied for days at the gates of the Cemeteries.

No further outbreak occurred until 1918 when the disease was pandemic, and the Gold Coast in common with other West African states suffered severely.

In August of that year, the first cases were landed from a steamer called the Shonga at Secondee, and consisted of twenty native members of the crew. About the same time passenger and other ships from England began to arrive with reports of large numbers of cases occurring on board during the voyage. Some of these were landed recovered or convalescent, while others were landed ill.

It was recognised that there was no means of stopping the entrance of infected cases into the Colony. The procedure of quarantine against infected ships was adopted in Togoland, but was not productive of any benefit, for after the disease became epidemic in/

in the maritime towns of the Gold Coast, there was a great stampede into the bush towns and villages, in the vain hope of avoiding infection, and many crossed into the adjoining countries over borders which it was impossible to protect.

The first cases that occurred in August were of a mild form, and the epidemic did not appear as if it were going to attain that virulence which characterised its ravages later.

About the middle of September, however, the disease recrudesced with extraordinary suddenness and virulence in Accra, and day by day reports were received at headquarters from the Coast ports and inland towns, of the severity with which the disease had renewed its activity.

Trade was practically at a standstill and it was found extremely difficult to carry on the most necessary operations of Public Sanitation.

In Accra with its population of close on 30,000 there was an average of sixty deaths per day for a fortnight, and then the disease subsided with almost as startling suddenness as it began. Altogether there were close on nine hundred deaths within a month, from Influenza and Influenzal Pneumonia.

In Secondees where there are works which employ
a/

a large number of labourers whose numbers were definitely known, a census was taken and the percentage of those who died was worked out at 4.94.

The actual number of cases that occurred could not be calculated as large numbers never presented themselves for treatment, but retired to their rooms, or struggled away into outlying villages and allowed the disease to work its will. The large mining camps had to close down, and some were affected much more severely than others.

House to house visitation was out of the question, as Medical Officers were busy day and night in the hospitals and dispensaries, and many of the native staff of nurses, dressers and dispensers were on the sick list.

The disease quickly became epidemic throughout the Colony owing to the migration of people that had taken place upon the occurrence of the first lot of cases.

The age-incidence of the disease was mostly in young adults and middle-aged life. Children under ten were not affected to any great degree, nor were people at the more advanced ages.

The character of the illness differed in no wise from that which was exhibited in other countries. The general symptoms were the same and throat conditions/

conditions were most marked, the congestion of the soft palate and rawness of the pharynx being extreme. Pneumonia of an insidious and indefinable type was an almost invariable complication, and more often than not it was bilateral.

The appearances which were seen at post-mortems during the next three or four months amongst people who had recovered from the pneumonia and had died of sequelae, were generally those of a septic bronchitis confined to the smaller bronchioles, which were denuded of mucous membrane, dilated and full of badly-smelling pus and debris. Bronchiectasis of the larger bronchi was not so common.

It will never be known what the actual number of deaths was in the bush villages and towns, but the ravages of the disease were enormous, and the conditions which prevailed in some parts appalling.

It was generally estimated that five per centum of the population of the Colony was wiped out during the epidemic.

Among Europeans the disease was generally not so fatal in its character, but in Accra where the white population numbered close on three hundred, there were nine deaths, and it is most remarkable that among the Medical Officers who were working at full pitch all over the Colony in strenuous efforts to cope with/

with the sick, the incidence of the disease was practically nil during the more virulent part of the outbreak.

The precautions that were taken lay chiefly in advising the public by pamphlet and house visitation of the necessity of leading a healthy life, of avoiding infection if possible, and of calling upon and acting upon Medical advice, immediately any appearance of the disease was suspected.

Auxiliary hospitals were started in all the larger towns, and many male and female members of the European population gave invaluable and heroic assistance in helping to run these hospitals in various capacities, and in administering to the sick.

Routine public health measures were not neglected and by concentrating labour upon the most necessary work, it was found possible to carry on without in any way permitting conditions to arise which would have been detrimental to health from causes other than those associated with the epidemic.

The greatest strain was put upon the staffs of the cemeteries especially, as in all the larger Towns at least, the relatives of each person who died insisted upon the deceased being coffined and buried in a separate grave. A large staff was maintained in Accra to prepare the number of graves required daily, /

daily, but fortunately, while the epidemic was in its first mild stage and labour was still available, I had given instructions for two hundred extra graves to be dug and these were available when matters became more serious.

As Medical Officer of Health I was responsible for the public health duties which included the dissemination of precautionary measures, control of registration of deaths and regulation of the cemeteries.

The staff of Sanitary Inspectors were instructed in house to house visitation, and they did excellent work in this way, gaining the confidence of the people and helping to stay any suspicion of a panic.

The outbreak of such a disease was undoubtedly looked upon as a visitation by the people at large, and many were the rites and ceremonials that were exercised in their efforts to stay its ravages. When its virulence had died down, a procession of barbariously garbed and painted women and children visited every road leading into the town and strewed it with offerings of all kinds of food and other materials, in order to placate the demon of the disease and prevent his further entry into the town.

X.

P L A G U E.

In 1908 there was an outbreak of Plague on the Gold Coast which affected many towns and villages and caused a large number of deaths. Rigid measures were taken to deal with it under the supervision of Professor Simpson, an expert in Tropical Sanitation, who reported upon it fully in his Memorandum to the Colonial Office.

From this date no further case was suspected nor known to occur, until 1917.

In February of that year the Senior of the Native Sanitary Inspectors reported to me that a large number of deaths from some mysterious illness was occurring at a village named Ofako, nine miles north-west from Accra. A surprise visit was made to this village the following morning by the Senior Sanitary Officer and the Pathologist, but, although they inspected every house in the village, they found no suspicious case of sickness, and the inhabitants denied all knowledge of anything abnormal.

A native inspector was left in the village, but although he was there for a fortnight he reported that no cases were occurring. On 4th March the same Inspector/

Inspector who had first reported to me, again came with information that there had been more deaths, and that a number of people belonging to Accra and affiliated by tribe to the Ofako people, had gone out there to perform fetish rites in order to drive away the sickness. He also said that a girl had come into the town with a swelling in her axilla and had consulted a native practitioner.

This native Inspector had been in the Medical Department at the time of the outbreak in 1908, and had been commended for his good work during that time. He undoubtedly was aware of the nature of the present outbreak and of the nature of the swelling, which the girl exhibited. She had slept in the town for one night but had again disappeared. A search for her was begun and the aid of the police was called upon, but although we traced her to several houses where she had stopped for a few hours, we had to give up after a four hours search. It was left to the same inspector to continue the hunt and he ultimately discovered her in a house on the outskirts of the town.

She was removed to the Contagious Diseases Hospital, and on examination she showed a pronounced swelling on the right axilla with a temperature of 102°F. No glands were found in the other axilla or in the groins.

The Pathologist punctured the swelling and made smears/

smears which showed organisms with typical bipolar staining. Guinea-pigs were injected with some of the exudate and died within thirty-six hours, and typical organisms were recovered from them.

The houses which she had visited were immediately shut up, and fumigated later, and the contacts were isolated.

A round-up of the people who visited Ofako upon the fetish ceremony was begun, and twenty-five were found and a strict surveillance put upon their houses.

The Senior Sanitary Officer detailed a Medical Officer for work at Ofako and two fresh cases were found there within two days of his arrival. It was now obvious that the inhabitants had tried their utmost to conceal the presence of the disease amongst them by removing the sick into the bush, and by burying the dead in out-of-the-way places. The village was in a very bad state and as it was impossible to find out where the cases had occurred and fumigate the infected places, groups of temporary houses were quickly run up upon a good site, and the old village was burnt and demolished.

Every one of the residents was inoculated with Haffkine's prophylactic serum, which had been ordered by cable from England upon the first suspicious characters of the disease being recognised.

A/

A strict watch was now kept upon all the inhabitants of the village by regular parades for examination and no further case was found.

The next case occurred in Accra and was that of a girl about five who had accompanied her mother to Ofako on the occasion of the fetish ceremony. She was put into Hospital and the contacts isolated.

Both these Accra cases died and the post-mortem appearances confirmed the diagnosis of plague.

On searching the Register of Deaths, I was able to connect up a large number of deaths that occurred in Accra, with Ofako. One series was most interesting in its sequence.

Three out of five deaths in the series had been registered on the certificate of native medical practitioners as occurring from different causes.

A husband, wife and daughter who belonged to Ofako, died at intervals of a week in Accra, and their funeral preparations had in each case been made by the same old woman, who, a week after the death of the third, was also taken ill and went to Ofako where she died. The little girl of five who developed Plague and died, was the granddaughter of this old woman, and had gone with her upon each occasion when she went to perform the funeral rites, and she had also gone with her mother to Ofako upon the fetish custom, /

custom, so that she had a double connection with the origin of the disease.

With the aid of one of the local sub-chiefs who in spite of the possibility of being ostracised by his fellows for giving information upon matters that concerned fetish, it was possible to trace the movements in Accra of all the people, who had migrated to and from Ofako, and all the houses were marked and fumigated in due course.

As Medical Officer of Health I was in charge of local measures and these can be briefly summarised.

- (1) A cordon of police was drawn around the town in order to prevent bodies being carried away at night time.
- (2) The town was divided into sections and inspectors detailed to visit every house during the day, and report upon any case of sickness which was suspicious, and a list was submitted to me each morning, which I personally investigated.
- (3) Burial permits were only issued upon the death certificate of the Government Medical Officers, and in all other cases where the relatives came for a burial permit for dead who had not been seen by a Doctor, a post-mortem was ordered if there was anything suspicious in the manner of/
of/

of death. The right was also reserved of ordering a post-mortem in cases where certificates were given by native practitioners. This measure was responsible for detecting the only non-imported case that occurred in Accra after the recognition of the disease.

- (4) Immediately a death was notified at the office, or was discovered by the Inspectors, a corporal and two police were put on guard over the house, and no one allowed in or out, until instructions were given that the guard might be removed. In this way we were able to rope in eleven contacts of the case mentioned in (3).
- (5) Bodies for post-mortem examination were removed by a special gang of intelligent labourers in a specially constructed cart, and all precautions against spread of infection by this route was taken.
- (6) Rat catching gangs were increased and the distribution of poison and traps to all who wished them was made free. The sealing of rat holes with cement was done by a special gang. A price per tail was advertised.
- (7) Haffkine's prophylactic serum was widely used especially in the more congested areas, and in public institutions like the prison and police barracks, and amongst the Sanitary labourers.

- (8) Fumigation with Sulphur of all the infected and suspected houses was undertaken, and also of a large number of houses in the neighbourhood of infected houses.

The non-imported case mentioned in (3) occurred in a house in the centre of the most congested area of the town, and this section was entirely surrounded by a fence of corrugated iron sheets sunk into the ground for two feet, and all the concrete sullage drains trapped and exits guarded to prevent the escape of rats, whilst fumigation was in process. The whole area took ten days to fumigate; and the work was done very thoroughly with Clayton Machines and by burning sulphur in basins. Large numbers of rats, bats, snakes and insects were destroyed.

Strict surveillance was maintained in Accra for some months but no further cases occurred.

Whilst these measures were in progress in Accra, a report of a suspicious death at a village called Temma, fifteen miles along the Coast to the East of Accra was reported, and a Medical Officer was sent down. Post-mortem diagnosis confirmed Plague and one more case occurred.

The connection of these cases with Ofako could also be definitely traced, as the inhabitants of the two/

two places were affiliated tribally.

Fumigation and demolition of infected houses was undertaken and strict surveillance exercised.

Six definite cases of plague were seen in the three places - Ofako, Accra and Temma - and each proved fatal. It was estimated however from the records, and from information obtained later, that there were thirty-nine deaths in all.

It is somewhat difficult to see why the disease should have been restricted to these places - the only possible explanation is that the tribally connected people when moving from their own place to that of their friends, always occupy the houses of their relatives and have very little to do with those outside their own tribe.

Strangers passing through such villages are usually put up in a small group of houses, called a Zongo, which is well away from the main village, and this was probably responsible for the localisation of the disease to Ofako and its related settlements.

The explanation of the outbreak of Plague in an isolated village after such a long period of quiescence is difficult to explain. There is nothing recorded of its previous existence there.

The only factor that can be adduced is a climatic one. The years 1915 and 1916 were very wet and it may/

may be that this combined with the uniform range of temperature that prevailed under a saturated atmosphere at the beginning of the 1917 rainy season, may have afforded more favourable conditions for the growth of the organism.

It is held in India I believe, although I cannot find the reference, that atmospheric conditions and temperature do influence the virulence of the organism.

XI.

DEVELOPMENT OF SANITATION UPON THE GOLD COAST.

Bowditch in his "Mission to Ashantee, 1819" says.- "Three respectable establishments, one at Cape Coast Castle, one at Accra (a rich and open country), and one at Secondee, (if we could not purchase Axim, which commands the navigation of the Ancobra) with an allowance of a thousand a year for a progress in the interior, (beneficial to commerce, science and humanity) would be productive of fame and honour, and probably of wealth to our nation."

This modest estimate is the beginning of the development of a country which at the present time is recognised to be the largest grower and exporter of cocoa, and whose last annual Treasury estimate of Government expenditure exceeded three million pounds.

DESCRIPTION OF THE COLONY.

The Colony is composed of three parts - the Gold Coast Colony proper, Ashanti and the protectorate of the Northern Territories.

It lies on the Gulf of Guinea between $3^{\circ} 15'$ West and $1^{\circ} 11'$ East Longitude, and the territory extends Northward from the sea for about 600 miles and has an average breadth of 200 miles.

Divisions. The whole area is about 100,000 square, of which the Northern Territories constitute almost half. The whole country is divided into provinces, and the provinces into districts for political purposes. The headquarters of each district is generally in the largest town and every district is served by a District Commissioner and Medical Officer who includes among his duties that of Medical Officer of Health, except in the case of four of the largest towns, where a separate Medical Officer of Health is now maintained as a whole-time office

GEOGRAPHICAL CHARACTERISTICS.

These in their bearing upon the climate are of a most varied type.

The country may be divided into three zones,- a Southern zone of bush and plains, a central zone of dense forest, and a Northern zone of open undulating grassy lands with scrub bush.

The forest zone is much more hilly than the others and the hills are intersected with large swamps, which are very incompletely drained by sluggish rivers. During the rainy season the swampy areas are therefore considerably increased.

In the more open zones the soil is more gravelly and contains a lot of ironstone or pisite outcrop. In the forest the soil is much richer from the accumulation of decayed vegetation. There are numerous lagoons along the Coast. These are often converted into rivers during the wet season, but at other times are imprisoned by a bar of sand. The largest river is the Volta which begins in the French country behind the Northern Territories, and during the wet season it overflows its banks for many miles on either side at different parts. From this it necessarily follows that large tracts of the country are valueless and uninhabitable.

Climate./

Climate. This is roughly made up of two seasons - a wet and a dry. The wet extends from April to November on the Coast, and May to October in the Northern Territories.

During the wet season the atmosphere is damp and oppressive. This oppressiveness is most marked at the end of the dry season when the air is saturated with moisture.

The "Climate" of the Gold Coast has always been considered the deadliest in the Tropics, and the word is used so loosely and covers such a multitude of hidden factors - not usually included in the strict definition of the term - that, in the absence of more definite knowledge, the number of deaths that occurred in the earlier days were grouped under this convenient shield as a causative agent. Climate is strictly the sum of the meteorological conditions that prevail, and these are influenced by the geological and vegetable variations. The saturated atmosphere, and the damp soil, incident upon such dense forest areas, were held to be causative of fatal diseases before the parasitic organisms, which found these conditions favourable for their growth, were recognised.

White people who take up their residence in Africa/

Africa put themselves among environments which are entirely foreign to their physiological growth and it takes a considerable time for the body to adjust itself to the meteorological conditions which prevail.

While such an adjustment is proceeding, it is only reasonable to expect that the body is more liable to disease and especially to such diseases as depend upon the meteorological conditions of the country of adoption.

Certain diseases due to specific organisms and more or less peculiar to tropical climates, have been recognised and their prevalence is undoubtedly due to the existence of certain factors, which are necessary for the growth and spread of the appropriate causative organisms.

Organisms grow best at certain temperatures and in certain media, and their virulence is often increased by passage through some host.

Tropical conditions provide the first two requirements for its own crop of organisms and the non-immune white immigrant affords a fresh pabulum for its growth.

The native races are not affected by the climatic conditions under which they live, in the same way as the whites, and they possess an acquired or hereditary immunity to certain of the specific organisms.

The/

The relatively greater virulence of tropical diseases amongst the white population depends therefore upon an entire absence of any immunity and upon the strangeness of their environments.

Population. This is generally reckoned to be about one and a half millions. The native population is a very mixed one indeed.

The Ashantis who inhabited the forest belt have been a much more warlike race than the inhabitants of the Coast, and the influence of their language and customs has extended north and south amongst the adjoining tribes. Education and European customs are much more advanced among the coast tribes - the Ashantis being more conservative.

The Northern Territories are inhabited by pagan races who talk dialects of Hausa, the language of the West African Mohammedan. The existence of the Hausa dialects amongst these pagan races is no doubt a relict of the ages when the Mohammedan swept down from the north and enslaved the whole area.

EARLY HISTORY OF MEDICINE.

A study of the early reports of the Medical Department of the Gold Coast is instructive in so far as they show how earnest was the search into the causation of Disease in face of the great difficulties that beset the workers of that time.

In the report of 1886-7 one Medical Officer in commenting upon the futility of sending in Quarterly Reports characterises them as 'mere linguistic riddles and an exercise of his ingenuity to express the same facts and ideas four times every year in different verbal sequences. Of course it would be altogether different if there existed the two essential data for such reports.- (a) Sanitary works and measures, either established or in progress and (b) vital statistics; but both of these are conspicuously absent in a climate which from time immemorial has been overshadowed with the curse of a bad name.'

Nevertheless the writer goes on to make his recommendations and a study of these and of those of other Medical Officers, shows how clearly and definitely it was realised that the only road to progress lay in the establishment of the essentials of Sanitation.

The habits of the people at that time were the result/

result of their environment. The natives had no settled occupations - a few were engaged in the employ of trading firms as boatmen and general labourers, but the men generally were idlers doing odd jobs occasionally, when they had some definite object in view such as the purchase of a wife. Mother nature lavished a food supply upon them - plantains, which the wife beat into fufu and savoured with palm oil, mangoes, bananas, oranges, limes, pineapples and various other fruits were to hand for the mere picking; and it cannot be wondered that there should be so pronounced a dislike for work and exertion, when the staple articles of food could be got almost for the mere asking, since the wife and children did all the collection and preparation.

These lazy habits of life were reflected in their mode of living, and a description of one of the Medical Officers of the condition of the towns and villages is sordid in the extreme. "No one who has not seen this town (Accra) can form the remotest idea of the frightful condition it is in after a night's rainfall. The lanes which intersect it are on an average four to six feet wide, some less. At the immanent risk of being infected by its poisonous emanations, I walked through the purlieus of the town one morning after a night's rain. The scene which met/

met my view and the foul stench which arose from the black mud of lanes and compounds churned up by natives and pigs are undescribable.

.... In two days I was knocked down with a fever and congestion of the liver. This may have been a coincidence, but it looks far more like cause and effect, more especially as my annual attacks of congestion of the liver come in the Harmattan season only.

.... The only remedy for the evil is to open up the town by wide streets and compel the natives to build their houses in some kind of regular order. The population is congested to an alarming extent and it has been shown by eminent statisticians that the mortality of towns varies with the density of population; indeed so invariable is the rule that it has been reduced by the late Dr Farr to a mathematical formula. And to the manner in which this population and for the matter of that the population of almost every other town on the Coast, is packed together, may be attributed a very large percentage of the sickness and mortality which exists amongst them when unseasonable meteorological conditions occur. Other conditions concur of course in raising the sick and death rates, such as filthy habits, indifferent food, the want of fresh vegetables, and especially intemperance, in the use of the villainous compounds imported/

imported here under the name of rum and gin, etc. Yet I feel assured that if we could give them in and around their dwellings, more air-space where nature's great purifiers, grass and trees, could be grown, the physical condition and with it as a direct result, the normal status of the people would in time discover a marked improvement."

Recommendations upon refuse disposal, latrines, water supplies, agriculture surface and subsoil drainage are included in the report and strongly put forward for early action.

The conformation of most of the towns and villages was such that with the proximity of the forest, the immediate environs of towns and villages were made use of for latrine purposes and for refuse disposal, and made prolongation of an excursion in that direction a most unsavoury undertaking.

Such conditions, although not so aggravated, still prevail in the smaller bush villages, which have not yet come under full sanitary control, but it would be a difficult matter to recognise the Accra of the last ten years from the description given above.

It is now a large scattered town of wide streets and open spaces, with an excellent system of surface drainage. Public Latrines, Wash Houses and Refuse Bins are conveniently disposed all over the town.

Three/

Three model townships have sprung up in the suburbs, where each house is situated in a large plot with outhouses and ample gardens, which are well looked after. An abundant supply of pure water is obtained from large water-works on the Puech-Chabal system of Purification. A sewage scheme was initiated before the war but had to be stopped and is again under consideration. Electric light and tramways are being installed at present.

The health of the town is guarded by a Municipal Council, with a Medical Officer of Health, two European Sanitary Inspectors in charge of a staff of twenty native inspectors. Five hundred scavengers and labourers are employed and motor dustcarts and motor watercarts patrol the streets. The public latrine system is still the pan-system but these are emptied twice a day by motor latrine vans, which carry the pans to a tipping depot which I designed in 1917. This depot was built at a cost of £1000 and can deal with two thousand pans a day. The pans are washed over troughs which are automatically flushed and the sewage carried well out into the sea. The pans are stacked for drying and the vans take away clean dry pans on each visit. Mosquito brigades are maintained in constant work, picking up receptacles likely to breed mosquitoes, and trained inspectors are constantly/

constantly on a round of house to house inspection. The people themselves have improved out of all recognition. Keen business men abound, the arts and crafts are widely practiced. The homes that are now built are substantial concrete buildings with asbestos-slate roofs, large living rooms and sleeping rooms, and with ample space around.

Building regulations are enforced and every application for a new building is closely scrutinised by the Medical Officer of Health, Sanitary Engineer and Building Inspector before permission to build is given.

The habits of the people have altered and public conveniences are appreciated and used. The newest and largest houses are fitted with bathroom and latrines.

The scale of living has become a much higher one and the moral tone of the people has improved in proportion with the recognition of the benefits of Sanitation.

E D U C A T I O N .

There is no doubt that in the older days the physical surroundings of the people were detrimental to any moral progress, and at that time education was only in its infancy and was represented by a few scholars who were ambitious, but not prolific of attainments. There was however a leaven of progress which was beginning to show in the spread of habits of industry and this was acknowledged in the report mentioned above as somewhat more than promising.

A strong plea for education in its widest sense was made. "The people require to be educated; educated, however, not only in the smattering knowledge of books, not alone in the acquisition of the mechanical arts which some erroneously believe to be the panacea for all their social deficiencies; educated, not by the half-and-half system so fatal to real progress, but educated so as to fit them for comprehending the value of the benefits of civilisation the people should be taught to feel by experience how much sanitation contributes to render life more agreeable and secure."

Education has done a lot to assist the progress of Medicine and Sanitation in the country, and it has had a stubborn foe to fight in native medicine.

There/

There is undoubtedly much that is good in the latter but there is also a vast deal of harm, chiefly from its intimate connection with fetish rites. Until superstition is cleared away - and this can only be done by centuries of education - it is useless to expect that the natives will appreciate fully the fruits of Medical Science which are brought to them so liberally. They are suspicious of it still, from the most savage of them to the most enlightened.

Even at the present time it is a frequent occurrence in the larger towns to find that a patient who is doing well under treatment disappears suddenly and when enquiries are made, the reply is that he has gone to his native village to get "native medicine" - so impatient is the native mind of results which are expected to be magical in their rapidity under the white man's treatment.

Such an incident may occur even in the history of the treatment of one of the most enlightened of natives.

They accept the white man's medicine in the same way as they accept his Education, his Religion and his Arts and Sciences, but behind it all there is an instinctive feeling that each one is part of the white man's special fetish.

I have seen men who have been educated in England and who have graduated in one of the most ancient professions and embraced her religion, and who have practised their profession for close on forty years under most civilised conditions, revert to the most primitive instincts when an occasion of great triumph arose. They donned their native dress with all its gaudy trappings and barbaric ornaments and joined wholeheartedly in the revels and ceremonials in which the less enlightened of their fellows indulged with accustomed abandon.

It is easy to carry the benefits of medicine to the native but it is not always possible to make him welcome the visitor and this is also true for all the weapons of European Civilisation.

We have gone a considerable way along the road guided by the more familiar of the sign posts raised for us by the pioneers in Tropical Medicine, but there is a long way yet to be traversed and many obstructions to be cleared away, before Education and Medicine come into their own.

S T A F F.

In 1886 the Staff consisted of a Chief Medical Officer and ten Colonial Surgeons - the total number of officials including West Indians in the Colony being seventy-two.

In 1893 the staff consisted of the Chief Medical Officer and sixteen Assistant Colonial Surgeons. There was no Sanitary Staff proper but eleven natives were employed as inspectors of nuisances under the Medical Officers. In 1914 the estimates provided for the Principal Medical Officer, the Deputy Principal Medical Officer, two Provincial Medical Officers, six Senior Medical Officers and sixty Medical Officers while the Sanitation Branch consisted of the Senior Sanitary Officer, two Junior Sanitary Officers, six Medical Officers of Health and six European Sanitary Inspectors.

The native staff of Sanitary Inspectors had increased to almost a hundred. During the war the number of Medical Officers was reduced by almost half at times, and necessitated prolonged tours and shorter vacations for those who were left behind.

The Sanitary Department is nominally controlled by the Principal Medical Officer while the Senior Sanitary/

Sanitary Officer is the administrative head and the Junior Sanitary Officers are mostly engaged on visits of inspection and in making suggestive and progress reports. Medical Officers of Health are stationed in the larger towns, while the Medical Officers in the other stations are supposed to make the Sanitation of their respective stations and district a very important part of their work, and are responsible to the Senior Sanitary Officer for this branch of their duties. The latest scheme for the re-organisation of the Service is shown in the appended Chart.

EXPENDITURE.

The expenditure upon the Medical Department is not included in the earlier Reports, but in 1893, the total amount expended upon Sanitation was put down as £3003.

In 1911, expenditure upon the Sanitary Department which was started as a distinct branch of the Medical Department in 1910, was £18,531 with an additional £3,300 upon Yellow Fever prevention, and another £10,000 among the three largest towns.

In 1914, the sum had increased to £54,104 for the maintenance of the Department and to £37,240 for Sanitary/

Sanitary Improvements independent of the amounts spent by the Mining Companies in the building of new villages and in improvements of Sanitation, and of the amounts spent by the Municipal Councils of the larger towns from money collected by rates.

The Estimates for 1915-6-7-8 remained about the same, for maintenance, but the sums voted for Sanitary Improvements were considerably reduced.

The figures for 1919 increased out of all proportion and the work done was only limited by the shortness of labour and supply of materials.

GROWTH OF EUROPEAN POPULATION.

In 1887 the number of Officials including West Indians in the Gold Coast Colony was 72. In 1893 the total strength was 128 and in 1912, 586; 1913, 740; 1914, 768; 1915, 700; 1916, 589; 1917, 597; 1918, 515: The increase from 1887 to 1914 is remarkable. The decrease after this was due to the number who were allowed to go on war service.

The number of Europeans employed by the Mining Companies varied from 953 in 1912 to 481 in 1915.

In 1919 with the cessation of hostilities and the resumption of trade, all classes of the European Population increased enormously. The Commercial concerns were multiplied and the numbers of white employees were increased out of all proportion.

The Causation of Disease is discussed at length in the Report for 1887-8 by one Medical Officer who attempts to find in the geological formation - "an upper layer of loose porous soil, underlaid by a stratum of impermeable rock" the proper amount of moisture for the miasma necessary for the development of malaria.

With the exception of Ainhum and Yaws, he states that there was no disease in West Africa which he had not seen in India. He associates "sleeping sickness with the progressive pernicious anaemia of Europe". Another Medical Officer, in his remarks upon Public Health states that 'the specific poison which emanates from the soil that we have by mutual consent designated "malaria" and as Sir Joseph Fayrer remarks 'is best known by its results' is the cause of almost all European mortality, especially so when it attacks a subject in whom previous organic disease has been established even to a slight degree.

Mortality Rate among the Classes of Europeans
Resident in the Gold Coast Colony.- per 1000.

	Official.	Non-Official or Commercial.	Mining.
1886	54	No figures	No figures.
1891	30.76	32.71	27.2
92	36.3	70.73	157.8
93	31.25	64.93	121.21
95	66.9	No figures	No figures.
1903	15.33	35.82	19.17
1906	15.	15.	18.
1907	8.10	16.72	13.59
1908	14.5	20.7	14.4
1909	11.4	12.1	11.9
1910	16.8	37.9	27.2
1911	7.0	23.1	17.3
1912	13.6	10.4	11.5
1913	8.1	8.7	5.3
1914	14.3	12.7	12.2
1915	10.0	14.7	4.1
1916	6.7	8.9	4.6
1917	15.0	15.3	8.3
1918	11.16	27.9	50.1

It will be seen from this table that there has been a steady decrease in the Mortality Rate until an average rate of 10 per 1000 was maintained between 1911 and 1917.

The rise in 1910 was due to the outbreak of Yellow Fever which occurred at Secondees and at several of the Mining Camps, when this disease claimed the majority of its victims from amongst the non-official or commercial and mining elements of the population.

The alarming rise in 1918 was due to the epidemic of Influenza which as can be seen, was also more fatal to the trading community and more particularly to the mining classes.

Long tours of service and hard work had devitalised the majority and had rendered them more liable to the ravages of the disease. It must be remembered that these death rates are all calculated upon communities of men in the prime of life - that is, between the ages of 20 and 50.

Tropical Diseases in the later years at least were responsible for a small proportion of the Deaths.

Conditions of life in West Africa especially amongst the Commercial and Mining Classes, lead them into excesses, which devitalise them and lead to the development of actual organic disease or render them more prone to specific tropical diseases.

Invaliding Rate among the Classes of European
Residents per 1000.

	Officials.	Non-Official or Commercial.	Mining.
1887	208	No figures	No figures
1891	153.8	175.2	324
92	100	141.4	381
93	78.12	32.46	243.42
95	111.6	No figures	No figures
1903	76.68	53.73	88.20
1906	97.	62	53
1907	54.05	53.90	52.09
1908	70.2	94.4	60.6
1909	38.8	43.5	34.1
1910	67.3	16.5	50.0
1911	47.7	33.0	33.6
1912	22.1	35.9	36.7
1913	40.5	57.4	39.8
1914	31.2	32.7	43.1
1915	30.0	41.3	29.1
1916	40.7	53.6	67.5
1917	31.8	62.6	66.8
1918	104.8	38.1	36.3

The tremendous fall in the Invaliding Rate is only broken in 1918 when the number of officials invalided rose to 104.8 per thousand. This was undoubtedly due to the large number who had been debilitated by long tours and excessive work and who were attacked by influenza and pneumonia during the epidemic of this year. The fall in the Mining rate of invaliding is also remarkable and dates from the time when the Mining Companies instituted an eight months tour for the underground men and nine months for the others. It was found that if men were kept out longer than these periods, the number of days upon the sick list increased as the time went on, and it was found it was financially sounder to send them home while they were yet fit, rather than to detain them while they were unfit for work and financially unsound units in the machinery.

These mortality and invaliding figures are instructive in so far as they show how much was done by the introduction of measures which tended to benefit the health of the residents.

It is not possible to give tables showing the effect of Sanitation upon the health of the native Community. Hospital records of native officials show a great improvement since 1890.

Registration/

Registration of Births and Deaths was made compulsory in 1912 in certain towns and districts, and since that time annual tables for these places have been compiled but the registration of births has been so inadequately carried out, that it gives no indication of the movement of the population. Infantile Mortality is still very high - reaching 300 per 1000 in most of the registration districts. Maternal causes which result in premature birth are the most potent in maintaining the high rate.

Among Adults, malaria, dysentery and pneumonia remain the chief causes of death.

The figures for the towns already under the Ordinance show a slight improvement, but the death rate is still very high.

The country as a whole is not ready for general compulsory Registration owing to the scattered nature of the villages, and to the fact that only a very small proportion of the population receive medical attention.

C O N C L U S I O N .

The Gold Coast with its "Climate" is, as has been said, unfortunately the home of a number of virulent parasites which find conditions most favourable for their life cycle in the fresh pabulum of the blood and systems of the immigrant white race; and the diseases which they produce are extremely difficult to cope with for the reason, that it is impossible to eradicate the intermediate hosts which harbour the parasites.

The systematic destruction of the breeding-places of mosquitoes by every known measure; the segregation of Europeans at night with the object of minimising the attacks upon them by 'infected' mosquitoes; the avoidance of exposure to mosquito bites by the use of nets and other artificial contrivances, the judicious use of quinine when such exposure is inevitable, the provision where possible of pipe-borne water supplies and the boiling and filtration of all drinking water - are precautions, whose purposes have been gradually and fully demonstrated and are to-day mere matters of common sense, which no one of any intelligence would willingly neglect whilst living in West Africa. Little more than/

than a score of years has elapsed since the necessity for many of these first principles dawned upon Europeans in the tropics, but the result is already to be seen in the enormous improvement in the death and invaliding rates. An immense amount still requires to be done, for it is impossible to deal with a country of the size and variability of the Gold Coast in the systematic way that the work upon the Panama Canal environs was undertaken, but the gradual reduction of the sources of infection, the control of recognised endemic foci, and a gradual improvement in general health conditions of particular localities is within the power of the Sanitary Control, and is being slowly but surely effected.

The onset of the War in 1914 was a tremendous set back. The large sums of money, which had been voted and spent for some years upon Sanitary Works and Improvements, had to be curtailed to the absolute working minimum, but, now that this is over and the vast resources of the Colony are being exploited with a great access of capital, larger sums than ever are being spent upon Sanitary Works of all kinds, and I have no hesitation in saying that the further advance of these will have the most far-reaching and beneficial effect upon the Public Health of the Colony, and that, while the progress that has been made in/

in the last twenty years is remarkable in its depth, the future years will show an even more rapid and striking development.

— REORGANIZATION OF MEDICAL STAFF. OFFICERS REQUIRED WITHOUT RELIEFS —

— DIRECTOR OF MED. & SAN. SERVICES —

— SECRETARY —

